

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT  
(PCT Article 36 and Rule 70)



REC'D 20 JAN 2005

WIPO PCT

Applicant's or agent's file reference 209643	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEAA16)	
International application No. PCT/NL 03/00834	International filing date (day/month/year) 26.11.2003	Priority date (day/month/year) 28.11.2002
International Patent Classification (IPC) or both national classification and IPC C02F1/14		
Applicant M.W. V.D. LINDEN BEHEER MAATSCHAPPIJ B.V. et al.		

- This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 4 sheets, including this cover sheet.  
  
☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).  
  
 These annexes consist of a total of 5 sheets.

- This report contains indications relating to the following items:
  - I ☒ Basis of the opinion
  - II ☐ Priority
  - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
  - IV ☐ Lack of unity of invention
  - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
  - VI ☐ Certain documents cited
  - VII ☐ Certain defects in the international application
  - VIII ☐ Certain observations on the international application

Date of submission of the demand  25.06.2004	Date of completion of this report  19.01.2005
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer  Veronesi, S  Telephone No. +49 89 2399-8348  

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. **PCT/NL 03/00834**

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, Pages**

3-7 as originally filed  
1, 2, 2a received on 17.12.2004 with letter of 18.11.2004

**Claims, Numbers**

1-8 received on 17.12.2004 with letter of 18.11.2004

**Drawings, Sheets**

1/4-4/4 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).  
☐ the language of publication of the international application (under Rule 48.3(b)).  
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.  
☐ filed together with the international application in computer readable form.  
☐ furnished subsequently to this Authority in written form.  
☐ furnished subsequently to this Authority in computer readable form.  
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.  
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. **PCT/NL 03/00834**

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes: Claims	1-8
	No: Claims	
Inventive step (IS)	Yes: Claims	1-8
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-8
	No: Claims	

**2. Citations and explanations**

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/NL 03/00834

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

Reference is made to the following documents:

D1: GB-A-2 016 938 (WATSON DEVELOPMENTS LTD JOHN) 26 September 1979

D2: US-A-4 328 788 (MELAMED AVRAHAM ET AL) 11 May 1982

Document D1, regarded as being the closest prior art, shows a method and plant for the desalination of seawater, wherein seawater stored in a reservoir and heated by solar energy is evaporated in an evaporator, after which the vapour thus formed is introduced into a condenser so as to obtain pure water.

The subject-matter of the claims of the application differs from the known method and plant in that the salt-containing water is passed through a heat exchanger disposed in a basin containing brine formed by several layers of water lying one above another in the basin, each layer of water having a higher salt content than a layer present there above, and the heat exchanger being disposed in the lowermost layer having a high temperature.

The subject-matter of the claims is therefore new (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as providing an inexpensive and efficient desalination of salt-containing water.

Using a heat exchanger disposed in the lowermost layer of brine, which has a high temperature appears to heat up the salt-containing water in an inexpensive and efficient way, so that vapour can be obtained in the evaporator.

This solution appears to be not obvious.

D2 describes the use of a basin containing brine formed by several layers of different salt content for storage of thermal energy, such as solar energy, and its supply when required. The use of such layered pond in the desalination of seawater is however not mentioned. Thus, it would not be obvious to combine D1 with D2.

The subject-matter of the claims is therefore considered to involve an inventive step (Article 33(2) PCT).

Method and plant for desalinating salt-containing water.

(92)

#### DESCRIPTION

The invention relates to a method for desalinating salt-containing water.

In GB-A-2.016.938 there has been described a method and plant for desalinating salt-containing water and thereby the salt-containing water (seawater) is extracted from a reservoir or basin and supplied to a boiler wherein boiling of the salt-containing water is performed. From said boiler vapour produced in said boiler is passed to a heat-exchanger for condensing.

US-A-4.328.788 discloses plant for the storage of heat in aqueous solutions and its recovery therefrom. During heat recovery the solution is extracted from a zone of a basin through openings, intake pipes, manifold and a further pipe and supplied to a heat-exchanger outside said basin. Thereafter said solution is recycled to said basin.

In US-A-4.328.788 there can not be found any indication with respect to the desalinating of salt-containing water.

The object of the invention is to obtain a method wherein the salt can be removed from the water in an efficient manner, using simple means.

According to the invention this object can be achieved in a method wherein the salt-containing water is passed through a heat exchanger disposed in a basin containing brine, formed by several layers of water lying one above another in the basin, each layer of water having a higher salt content than a layer present there above said brine being heated by solar energy and the heat exchanger being disposed in the lowermost layer of water having a high temperature, whereupon the salt-containing water that has been heated in the heat exchanger is passed through an evaporator for evaporating at least part of the salt-containing water, after which the vapour thus formed is introduced into a

condenser so as to obtain water from which the salt has been removed.

When using the method according to the invention, use is made of the fact that a layer of brine having a comparatively a high salt content that has been formed in a basin can heat up to a comparatively high temperature under the influence of the radiation from the sun. Using a heat exchanger disposed in said layer of brine, which has a high temperature, the salt-containing water can be heated up in an inexpensive manner and subsequently be supplied to an evaporator, in which water vapour free from salt can be formed, which water vapour is subsequently subjected to a condensation process.

Thus, a method that operates at least substantially exclusively on solar energy is obtained, which makes it possible to achieve an inexpensive and efficient desalination of salt-containing water.

A further aspect of the invention relates to a plant for desalinating salt-containing water, which is in particular suitable for carrying out the method as described above, wherein the plant comprises a basin that contains brine, formed by several layers of water lying one above another in the basin each layer of water having a higher salt content than a layer present there above and to be heated by solar energy, in which a heat exchanger is disposed in the lowermost layer of water, wherein means for supplying the water to be desalinated are connected to an inlet of the heat exchanger and an inlet of an evaporator is connected to an outlet of the heat exchanger, whilst an outlet of the evaporator is connected to means for condensing the water vapour that has been formed in the evaporator.

Using the invention, a simple and efficient plant for desalinating water can be obtained, which plant can operate automatically and practically unattended.

The invention will be explained in more detail below with reference to the accompanying schematic figures.

2a

Figure 1 schematically shows a plant according to the invention.

Figure 2 schematically shows part of the basin used in the plant that is shown in Figure 1, in which three layers, each having a different salt content, are present in the basin.

Figure 3 schematically shows a device for supplying salt-containing water to the basin.

Figure 4 schematically shows part of the basin used in the plant that is shown in Figure 1, with a catwalk extending over part of the basin.

Figure 5 is a schematic top plan view of Figure 4.

The plant that is shown in Figure 1 comprises a basin 1, whose bottom side is spaced from the ground water level 2 by a distance of at least  $\pm 2$  m.

Near the upper side of the basin 1, a pipe 3 opens into the basin 1, via which pipe salt-containing water, in particular seawater, can be pumped into the basin.

A pit 4 is furthermore present near the basin 1, which pit

17.12.2004

1

(92)

## CLAIMS

1. A method for desalinating salt-containing water, wherein the salt-containing water is passed through a heat exchanger disposed in a basin containing brine formed by several layers of water lying one above another in the basin, each layer of water having a higher salt content than a layer present there above said brine being heated by solar energy and the heat exchanger being disposed in the lowermost layer of water having a high temperature, whereupon the salt-containing water that has been heated in the heat exchanger is passed through an evaporator for evaporating at least part of the salt-containing water, after which the vapour thus formed is introduced into a condenser so as to obtain water from which the salt has been removed.

2. A method according to claim 1, characterized in that a lower layer of water having a salt content of  $\pm 24\%$ , a middle layer of water having a salt content of  $\pm 15\%$  and an upper layer of water having a salt content of  $\pm 0-4\%$  are formed in the basin.

3. A method according to claim 2, characterized in that each layer of water is formed to a height of  $\pm 1$  m.

4. A method according to any one of the preceding claims, characterized in that the water to be desalinated is supplied to a heat exchanger disposed in the basin from a pit that contains water, in which pit a heat exchanger is disposed, through which the condensed water is passed.

5. A method according to any one of the preceding claims, characterized in that the water vapour that has been formed in the evaporator is subjected to a condensation process in a condenser, to which a cooler for supplying cooled air to the condenser is connected.

6. A plant for desalinating salt-containing water, comprising a basin that contains brine formed by several layers of water lying one above another in the basin each layer of water having a higher salt



content than a layer present there above and to be heated by solar energy, in which a heat exchanger is disposed in the lowermost layer of water, wherein means for supplying the water to be desalinated are connected to an inlet of the heat exchanger and an inlet of an evaporator is connected to an outlet of the heat exchanger, whilst an outlet of the evaporator is connected to means for condensing the water vapour that has been formed in the evaporator.

7. A plant according to claim 6, characterized in that said plant comprises a pit, to which seawater to be desalinated is supplied, and from which the water is carried to the heat exchanger that is disposed in the basin.

8. A plant according to claim 6 or 7, characterized in that the evaporator is connected to a condenser, and in that the plant comprises a pump by means of which water that has condensed in the condenser can be transported to a receiving basin for the water.